RELATIONSHIP OF THE IBM WRITING TO READ PROGRAM TO LOWER ELEMENTARY ACADEMIC ACHIEVEMENT

A Thesis

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by

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An abstract of a Thesis by
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The problem. This study measures kindergarten and first grade Iowa Tests of Basic Skills (ITBS) reading, language, and composite scores for student cohorts. One group received kindergarten reading instruction through IBM's Writing to Read program while the other group received kindergarten reading instruction through traditional methods.

Procedure. The ITBS scores were collected from 112 students and grouped into Writing to Read students and traditional instruction students. An analytical covariance was performed on first grade scores for each subtest, with compensations for group difference through kindergarten scores. Non-statistical post hoc comparisons were also made on second the third grade scores through graphic trendlines.

Findings. Significant differences between the groups were found at the kindergarten level. This prompted the need for the analysis of covariance. At the first grade level, significant differences between the groups were found in the Language subtests only. In the post hoc comparisons, all differences, significant or not, disappeared by third grade.

Conclusions.

1. Practically significant increases in first grade reading, language, and composite scores were recorded by students who had been taught through IBM's Writing to Read program. Statistically significant increases were recorded only for composite scores.

2. By the third grade, scores recorded by students taught via Writing to Read as kindergartners were not significantly different from similar students taught through traditional methods in the experimental or baseline groups.

3. It is unlikely that the computer-assisted component of the Writing to Read program had even the short-term effects demonstrated in the early grades.

4. Third grade score means in the experimental group were slightly lower than could have been expected by historical averages, but not significantly lower.

Recommendations.

1. The IBM Writing to Read program was an effective method of increasing student test scores in the early elementary grades in the short term.

2. Further research is needed on the specific skills taught by Writing to read.

3. Further longitudinal research is needed on the possibility of student burn-out in third grade and beyond as a result of increased kindergarten reading instruction through Writing to Read.

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Chapter I

INTRODUCTION

With the introduction of computer technology into society in general through the personal and micro-computer came an interest in its use in the educational processes. Educators, always searching for better techniques by which to teach children, looked hopefully at the computer as a new and promising tool. As soon as computers had been sized down and made user-friendly, they were brought into the schools (Hall, 1982). In 1984, International Business Machines (IBM) tested a new computerized reading/writing program designed to increase their involvement in the computer-assisted instruction market which it named Writing To Read (WTR). The program described by IBM in the Writing To Read Teachers' Manual:

> Writing to Read is a computer-based instructional system designed to develop the writing and reading skills of kindergarten and first-grade students.
>
> The System works within the context of a planned learning center, called the Writing to Read Center. In this center, students use a

> variety of equipment and language arts materials organized as learning stations. In the Writing to Read System, the teacher is the educational manager, and as such, monitors how each student's learning needs are being served. (Martin, 1986b, pp. 1-3)

Writing to Read includes at least five learning stations. These include the Computer Station, the Work Journal Station, the Writing/Word Processing Station, the Listening Library Station, and the Make Words Station. Other learning stations can be added at the option of the individual school. These could include stations involving language, games, puzzles, art, etc. The Work Journal Station, the Writing/Word Processing Station, and the Make Words Station are an attempt to teach reading through writing, hence the name of the program (Powell, 1984).

The heavy emphasis on writing was no accident. The program's developer, John Henry Martin, created the system as an application of his theory that children best learn to read by being taught to write. Once developed, the program was tested on a sample of 900 private and public school students. The results of this research were released in July 1984 through an executive summary of an Educational Testing Service's evaluation. In effect, IBM released seven defensible conclusions, but only one mentioned success at reading, conclusion 4:

> In Reading, Kindergarten Writing to Read Students Have A Significant Advantage Over Comparison Students. In Grade 1, Writing to Read Students Compare Favorably with Other Students. (Murphy & Appel, 1984, p. 9.4)

The conclusion was sketchy at best. First, it was impossible to tell if the control group of kindergartners were given any type of reading instruction at all. If not, it would hardly be surprising that any type of reading instruction, not necessarily WTR, would produce significant results in the experimental group. If the control group received no reading instruction due to a social rather than an academic kindergarten, all that has been shown is that reading instruction will produce significant results in kindergartners in the short run. Second, when the study stated that first graders using WTR "compare favorably" to first graders who do not use WTR, the data actually demonstrated no statistically significant differences between the two groups (Murphy & Appel, 1984). Insignificant results can be attributed merely to chance variation.

Purpose and Significance of the Study

Regardless of the ambiguity of the IBM conclusion on the WTR's efficacy on improving reading scores, the IBM Writing to Read Program is finding its way into numerous school districts as they attempt to find ways to improve reading abilities of their students.

There are several implications of this. First, school districts are spending tens of thousands of educational dollars on these computerized systems initially and thousands of dollars each year after on work journals, maintenance agreements or repairs, supplementary materials, and, in some cases, salaried employees specifically for the WTR center. If WTR is an effective program, these are dollars well spent. If not, they are dollars wasted that could be better spent on other, more educationally effective programs. Second, IBM is releasing other related programs such as the Getting Ready for Writing to Read Program and Writing Labs. This will mean more dollars, more training, and more materials. Obviously this is a problem if the core program, WTR, is ineffective.

Third, the opponents of academic kindergartens, in general, point to early elementary student burn-out and stress on school whenever academic lessons are forced on students too early (Gallagher & Coche, 1987; Hatch & Freeman, 1988; Hills, 1987; Elkind, 1986). A program designed to teach reading to kindergartners, one year earlier than with traditional methods, may certainly risk this type of harm to students. If in fact reading scores are not significantly improved, even risking this sort of burn-out would be pointless. Finally, there is a curricular issue. Most schools have numerous Apple computers, due to the reasonable expense and wide-ranging software of Apple computers. Fewer have IBM computers in the classroom. By creating a writing lab of IBM computers, the school has effectively eliminated their usefulness in many other instructional areas unless the district is willing to purchase a wide array of software for both types of computers. If IBM has a very effective computer-assisted reading program, perhaps Apple should be abandoned. If not, perhaps IBM computers should not be brought into the classrooms. Either way, there is a decision to make. All of these considerations turn on one question: Is the IBM WTR Program more effective in teaching reading than traditional methods?

Rationale for the Study

Computer-assisted instruction (CAI) is no longer a new endeavor. It has, in fact, already been shown that in many curricular areas and with many students it can reap improved results in learning (Valdez, 1986). This study, then, has attempted to answer only a very specific question, a question which seemingly must be answered for all new CAI programs, especially until some very clear components of all CAI programs are discovered which correlate significantly with program and student success. Is the IBM WTR Program more effective in teaching reading than traditional methods? Other questions about WTR will surely arise but this question seems to necessitate an answer before any others can be seriously studied.

Chapter II

LITERATURE REVIEW

History of Computer-Assisted Instruction

The history of computer-assisted instruction (CAI) depends upon the history of computers and is, therefore, a short one. The first computer was actually built in 1949 (Hall, 1982). Computers infiltrated the education system in a top-down fashion, beginning with higher education in the 1950s (Walker, 1980), secondary schools in the middle and late 1960s, and elementary schools soon after (Palmer, Kueker, & Stowe, 1987). For reasons of cost and physical space, however, computers did not enjoy wide popularity in the schools while they depended on main frames. With the development of microcomputers, their availability to schools became widespread (Hall, 1982). One of the first microcomputers to move into the schools was the Commodore PET, occurring in 1977. Thus, the research on CAI began only slightly earlier than this (Palmer et al., 1987).

Nevertheless, some of the theory behind CAI began decades before it was actually made possible.

Skinner's concept of "teaching machines," designed to positively reinforce and provide feedback for the learner, soon developed into "programed instruction," an unvarying sequential presentation of learning tasks. Quite naturally, it was soon assumed that if the simple machines of Skinner and his disciples could teach students, then computers with software developed along similar lines should teach students even more effectively (Gentile, 1967). This concept was soon utilized by software producers in the development of instructional software and is still a component in much software today (Balajthy, 1987b). Programmed learning is today, however, a dead term. Instead, software, which is still based on Skinner's sequential, unchanging format, is referred to as linear programming.

> In linear programming, then, programs consist of a sequence of frames, each of which represents a small step toward the desired learning behavior. . . . The sequence of frames in a linear program is characterized by its unvarying nature. The 'line' of learning is the same for every student. (Balajthy, 1987b, p. 9)

Educators and the designers of programmed instruction soon realized that linear programming was inappropriate because of differing learning styles in children. Though it is certainly not the case that linear programming has disappeared, its continued usage in new software is due to ignorance of better methods (Balajthy, 1987b).

Even with CAI dependent upon linear programming, however, the "dynamic appeal of computers to students" (Martin, 1986a, p. 33) carried CAI until better software could be developed. Thus, educators have continued to add microcomputers to classrooms (Dudley-Marling, 1985). By 1985, in fact, 25% of American schools were using computers (Valdez, 1986). Today, nearly 100% of schools are using microcomputers (Bowker, 1988). Interestingly, educators quickly joined the public outcry for more computer-based education in the early 1980s before much real research had been done on any systems besides a few university sponsored CAI programs which were heavily dependent on main frames (Balajthy, 1988). But with the microcomputers came a blizzard of research (Colorado, 1988). By 1990 it is possible to say that microcomputers are effective teaching tools (Balajthy, 1987a; Balajthy, 1987b; Brandon, 1988; Dudley-Marling, 1985; Shuman, 1987; Teague, Teague, & Marchionini, 1987; Valdez, 1986). In the future, as new technological and theoretical advances are made, the power of microcomputers will expand to unforeseeable degrees.

Early CAI Programs

The two earliest major CAI projects were the Stanford CAI System and the University of Illinois' PLATO (Programmed Logic for Automatic Teaching Operation). The reading component of Stanford's program begin in 1964 (Tomlinson, 1980) and was designed to act as a total reading instruction program for disadvantaged lower elementary children. It was essentially a drill and practice program, though it included branching, the interactive ability of the computer to present instruction dependent on the needs of the individual student (Bradley, 1985). The program, co-sponsored by IBM, did produce significant improvement in reading achievement (Blanchard, 1980; Obertino, 1974).

A design which began in 1959, PLATO, was an attempt to create an entire computer-based academic curriculum. Its elementary and reading projects were implemented and tested in the 1970s. Positive effects resulted from its use in elementary classrooms (Swinton, 1978). As a program, it relied heavily on interaction, feedback, and reinforcement (Obertino, 1974).

Since that time, hundreds of other CAI reading programs have been developed, many with significant achievement outcomes (Balajthy, 1987a; Clariana & Schultz, 1988; Harris, 1985).

New Modes of Reading Software

In the 1960s computer-assisted instruction was synonymous with drill and practice. But with a plethora of new reading software has also come a slow but undeniable breaking away from linear programming. Thus, the definition of CAI broadens from just drill and practice to "one where the computer is used to assist in the realization of particular learning objectives across the curriculum" (Bowker, 1988, p. 45). Currently, there are four discernible CAI reading categories which meet this definition. The first of these is of course linear programming, which is basically drill and practice. While some studies have shown it to be more effective than traditional instruction, it is still criticized for being unimaginative and inconsistent with the notion of differing learning styles (Martin, 1986a).

Other studies have shown drill and practice producing mixed results (Balajthy, 1987a; Edwards, Norton, Taylor, Weiss, & Dusseldorp, 1975; Vinsonhaler & Bass, 1972). A second category is CAI as direct instruction, the learning of new skills through the computer (Balajthy, 1987b). Generally, direct instruction through CAI has not demonstrated better results than direct instruction through the teacher (Thompson, 1984). A third category is CAI as a supplement to traditional instruction. This occurs when a teacher instructs the students in a new skill and computer software is used to provide guided practice and enrichment in the new skill. The use of CAI as a supplement has proven more effective than traditional instruction alone (Brandon, 1988; Bowker, 1988; Edwards et al., 1975; Valdez, 1986). Finally, CAI may be used as outside or even enriched reading-related activities. Examples of this include interactive computer-based periodicals, information exchanges, data-base library searches, etc. Since these programs are based less on instruction than on indirect reading activities, most of the studies on them have been qualitative rather than experimental (Anderson, 1988; Broadley, 1986; Rubin & Bruce, 1984). An overall problem of determining the effectiveness of any one of these categories is the blurring of lines between them. One researcher's direct instruction may be another researcher's supplemental instruction. Unless clearer definitions are made in the field of software research, any conclusions about the effectiveness of each category are questionable, including the findings described above. This is especially true when one attempts to determine the advantages of CAI.

Advantages of Computer-Assisted Instruction

The first and foremost advantage of CAI is that, in some cases, it is effective. In fact, it has been shown to be effective with elementary students with numerous specific characteristics (Argento, 1980; Leton, 1984; Litman, 1973; Rosegrant, 1985; Shuman, 1987; Teague et al., 1987). A second advantage, though necessarily temporary, is the novelty of CAI. Just as the motion picture projector, radio, and television were hailed as educational advances, so has been the computer (Martin & Friedberg, 1986). As their novelty has worn off, however, the expectations for their instructional possibilities has waned. Even though novelty will not last forever, it has already allowed CAI to survive through the drill and practice era and can still be counted on to boost outcomes (Balajthy, 1987a; Krendl & Lieberman, 1988; Scott & Barker, 1987). There is even an advantage in the gradual decline in CAI novelty in that it is resulting in educators refusing to accept only drill and practice software and demanding more diversified programs (Tucker, 1985). The interactive nature of CAI is another of its advantages. Unlike most other materials in the classroom, the microcomputer can mechanically respond to the needs of the student, hopefully in a way that will improve learning (Bradley, 1985; Kenneke & Suzuki, 1981; Krendl & Lieberman, 1988; Mason, 1984; Shuman, 1987; Tomlinson, 1980). It can also respond much more quickly on a consistent basis than the teacher (Mason, 1982; Tomlinson, 1980). Another benefit is the computer's ability to individualize instruction, thereby allowing the learner to proceed at a self-paced rate (Bradley, 1985; Colorado, 1988; Kenneke & Suzuki, 1981; Krendl & Lieberman, 1988; Martin, 1969; Martin, 1986a; Martin & Friedberg, 1986; Tomlinson, 1980). The computer is also very nonjudgmental, an important characteristic for lower elementary instruction (Bradley, 1985; Mason, 1984). Related to this is the computer's ability to repeat instruction and questions an infinite number of times without losing its patience with a child (Colorado, 1988; Mason, 1987; Shuman, 1987). Its patience can also allow the teacher to have more patience since CAI allows her more time to spend on students rather than grading papers, recording of progress, and other administrative tasks (Bowker, 1988; Colorado, 1988; Henning, 1981; Kenneke & Suzuki, 1981; Mason, 1984; Tomlinson, 1980). Using computers as instructional tools also allows more creative combinations of graphics, text, and movement (Mason, 1987; Scott & Barker, 1987). This ease of manipulation also makes the computer an excellent writing tool. Proponents have attributed the word processor with the ability to motivate students to do more reading and writing, to make revision quicker and easier, to allow students to be more efficient writers, to encourage the view of writing as a process, to promote more experimentation in writing, and to build a more logical bridge between speaking, reading, and writing. Overall, it will turn students into writers (Barber, 1982; Dudley-Marling, 1985; Heffron, 1986; Henning, 1981; Krendl & Lieberman, 1988; Rhodes, 1986; Smith, 1984; Smith, 1985). Computer-assisted instruction can not only encourage students to write but it can also motivate students in any learning situation (Anderson, 1985; Colorado, 1988; Henning, 1981; Krendl & Lieberman, 1988). To a lesser extent in the research, CAI has been found to teach computer skills (Neufeld, 1982; Rhodes, 1986), improve teacher effectiveness (Schaudt, 1987), enhance communication between parents, students, and school (Mason, 1984), focus attention (Mason, 1984; Rhodes, 1986), reduce the amount of time to learn a task (Edwards et al., 1975; Krendl & Lieberman, 1988), foster creativity (Broadley, 1986), and generally assist students in deepening their understanding by making abstract concepts concrete (Barber, 1982; Krendl & Lieberman, 1988; Mason, 1987). Thus, CAI clearly has a wide range of potential benefits.

Disadvantages of Computer-Assisted Instruction

Though the list of potential benefits is long, so is the list of CAI's disadvantages. Historically, the greatest disadvantage was cost. This disadvantage, however, was somewhat overcome through the introduction of microcomputers (Hall, 1982; Henning, 1981). As a result of this problem early on, when computers did enter the classroom they were often few in number which limited their classroom usefulness and created negative impressions about CAI in the minds of teachers (Balajthy, 1987b).

Probably the most omnipresent complaint about CAI currently is a lack of relevant, quality software (Balajthy, 1987a; Balajthy, 1988; Bradley, 1985; Kenneke & Suzuki, 1981). This criticism usually boils down to educators' dislike for the specific drill and practice software which is, according to critics, worth little more than piles of worksheets, completely failing to take advantage of the interacting and branching possibilities of CAI and making no attempt to develop software based on learning theory (Balajthy, 1988; Brandon, 1988; Kirkland, 1984). Drill and practice software is also seen as giving students the incorrect perception that learning is monotonous and unconnected to real life (Trumbull, 1986). The bulk of these criticisms, since they are specifically directed at the category of drill and practice, can be discounted for CAI's other three categories. While it is true that the advances in hardware have outpaced the advances in software (Bradley, 1985), it is also the case that software is being produced for all types of students and all categories of CAI (Colorado, 1988). A final criticism of CAI software is that it is determining the what and how of teaching. Some educators feel that software is determining the content of instruction and how that content is presented to students (Balajthy, 1988; Bowker, 1988). If this is the case, it is more a criticism of education than it is of CAI. There is also clear evidence that teachers are abandoning drill and practice software and moving toward more creative and instructionally based software (Balajthy, 1985).

Other criticisms are based on the social effects of computers. Some vehemently oppose replacing teacher instruction with computer instruction due to the loss of the human factor (Balajthy, 1987b). Their concern was that computer stations would turn students into isolates without social skills or social inclinations (Balajthy, 1987a). Others presented simple a priori objections to the notion of machines teaching humans (Bowker, 1988). Since a trend in CAI seems to be a move toward computers as supplemental tools and since some studies are now demonstrating increased social interaction from computer learning stations, the sociopath theory of CAI seems to be unfounded.

Miscellaneous other concerns have also been voiced about CAI. Lower retention rates (Edwards et al., 1975), lack of multi-sensory stimulation (Bowker, 1988), health concerns (Mason, 1987), exaggerated claims about computer effectiveness and the need for computer literacy (Balajthy, 1988; Bowker, 1988), absence of affective components in CAI (Balajthy, 1988), and illegible printouts (Mason, 1987) are valid issues, though it could also be argued that most or all of these may be eliminated through advances in hardware, software, and research.

Criteria for an Effective CAI Program

From the conclusions that some CAI software is effective, it can be logically inferred that there must exist certain criteria that lead to this success. The research lists literally hundred of such criteria. These can probably be aggregated into four groups.

Group 1: Software

The software used in an effective CAI program must be consistent with current learning theory in general and current learning theory in the specific content area in which it is to be used. This means the abandonment of pure drill and practice software and the transition to and testing of software which is written with these theories in mind (Anderson, 1985; Anderson, 1988; Dudley-Marling, 1985; Krendl & Lieberman, 1988; Sankar, 1986).

Group 2: Personnel

Though some early protagonists of CAI predicted teacher-less classrooms, it has become clear that the teacher has a critical role in the success of any CAI program. Initially, teachers must be convinced that the CAI program will be a positive addition to their teaching materials (Bowker, 1988; Wepner, 1988). They must also be willing to monitor the program, providing the necessary adjustments, reinforcement, and follow-up (Tomlinson, 1980). The CAI program, then, must be used as a supplement to regular classroom instruction by the teacher, not as a substitute. Early on, the Stanford CAI program abandoned the idea that all of beginning reading instruction could be presented through CAI for this reason (Blair, 1986; Bowker, 1988; Fletcher & Atkinson, 1972). To accomplish all these tasks, teachers clearly must be well-trained in the operation of and their role in CAI (Blair, 1986; Cooperman, 1985;

Sturdivant, 1986). This training will not be provided without strong administrative support (Blair, 1986; Sturdivant, 1986).

Group 3: Intrinsic Interest

It is no longer enough for CAI to simply involve the computer to make it intrinsically interesting to the learner. The program should be motivational, creating a natural interest in the learner which can then be channeled into the task at hand (Cooperman, 1985; Dudley-Marling, 1985; Martin, 1969; Sankar, 1986). One method of building this motivation and appealing to different learning styles is the designing of multi-sensory programs. As more senses are involved, the likelihood that any specific learner's primary learning style will be utilized increases.

The result will be a more active and motivated learner (Bowker, 1988; Burnett & Miller, 1984; Martin, 1969). A final way to develop intrinsic interest is by beginning with extrinsic interest, better known as reinforcement. While reinforcement can benefit any CAI program, it is especially crucial during the initial teaching of a skill. This reinforcement, consistent with the ideas of Skinner, should be positive and response-specific (Balajthy, 1984; Balajthy, 1987b).

Group 4: Learner Specific

Good CAI programs are able to individualize instruction. This means that the computer attempts to match instruction to the specific abilities of the student. In order to do this, some amount of student self-direction is necessary in order for the student to assist the computer in picking learning tasks which require further elaboration. It also requires "branching" software, software which shifts the instructional task according to the past achievement of the student. Linear programming either makes no attempt at doing this or does so by exact repetition of past instruction. The disadvantage of the linear repetition is that the student is exposed to an instructional method that has already failed once. Thus, branching is deemed superior (Krendl & Lieberman, 1988; Martin, 1969; Martin, 1986a; Sankar, 1986). Implicit in all of this is the monitoring aspect of the CAI program. If the computer is to direct the learner to repeated instruction, it must have some basis on which to make that decision. This requires monitoring (Martin, 1986; Sankar, 1986). Also necessary to individualization is interaction between the computer and the learner. The student must demonstrate learning by answering questions the computer poses. Having monitored these responses, the computer provides feedback for the student and recommendations on further instruction (Bork, 1986; Martin, 1969; Martin, 1986a; Sankar, 1986).

Having discovered these criteria for effective CAI, the next logical step is to discern the match between WTR and these criteria. In order to do this, it will first be necessary to describe WTR at length.

The Writing to Read Program

Dr. John Henry Martin, developer of WTR, has had a long and distinguished career in education. As a teacher, principal, superintendent, and researcher, he has made that all important connection between practitioner and academician (Martin, 1986b; Sturdivant, 1986). He has written articles on topics including teacher education, the historical background of the elementary school, and education for the disadvantaged. But his area of greatest interest seems to be educational technology, the topic of numerous articles since 1967.

Since that time, his belief that technology had to be brought into the schools merged with his theory that "children best learn to read by being taught to write"

(Martin, 1986b, pp. 1-9). His belief that technology could improve the educational system in the United States stemmed from the many perceived benefits that computers could bring into the classroom, as discussed in the section, Advantages and Disadvantages of Computer-Assisted Instruction. His theory, however, comes from 35 years of experience and a great deal of thoughtful reading.

Before discussing the development of WTR, it will be useful to give a brief description of the five learning stations involved:

Computer Station. The major purpose of this station is for students to work through the 30 cycle words, 30 words to add to their vocabulary which will also identify for them the 42 phonemes. Once they know these phonemes, they should be able to write any word they can say. Between 12 and 15 minutes is spent at this station per child per day. In addition to the 30 cycle words and the many activities designed to produce mastery of them, the computer will also assist students in making new words which are similar to the cycle words, present "silly sentences" in order to move the student from single word writing to sentence writing, and introduce word games designed to increase the speed with which students can spell the cycle and related words.

Work Journal Station. This station has the students writing the phonemes on paper and keeping track of their progress. Students are instructed on what letters to write via tape recorders and headphones. Work journals are designed to be taken home and shown to parents. Also included in this station are make word pages, on which students write words that rhyme with cycle words, and review pages.

Writing/Word Processing Station. Even over the few years that WTR has been in existence, there have been modifications in the stations. Initially this was called the Writing/Typing Station in which students wrote or typed stories. However, as it was found that word processing was a more motivating method of writing, the computer replaced the typewriter. The Writing/Word Processing Station has students writing their own stories using cycle words and any other words they can creatively spell. The purpose is to have students improve their writing and improve their reading through their writing. They then learn to rewrite and revise their stories quickly and easily on the computer. When a final draft is complete, students will illustrate their story on the top half of the page.

Listening Library Station. At this station students listen to classic stories in children's literature on audio cassette. This is designed to give them an appreciation of literature, and, since the stories are read slowly, it allows the student to read each word in an accompanying book as it is said. Schools are encouraged to create additional cassettes, but WTR provides a number of them. The WTR cassettes are extremely expressionless so as to, according to IBM, not frighten the young listener.

Make Word Station: Students create words out of string, sand, pencils, letter cards, floor tiles, and numerous other materials in order to involve senses other than hearing and vision in the learning process. In addition, this station includes a Make Words Game and a WTR Bingo. When WTR first began, there were two stations called Make Words Station and Multi-Sensory Materials Station. These have been combined into this station (Martin & Friedberg, 1986; Martin, 1986b; Sturdivant, 1986).

The conceptualization of Writing To Read came on two levels, the theoretical ideal and the practical application. The theoretical precursors of WTR, in Martin's mind, include Jean Piaget, Jerome Bruner, and Maria Montessori. Piaget's contention that children have pre-existing cognitive structures led Martin to believe that educators should design software and curriculum in general to closely match those mental structures. The result would be increased learning. Bruner's call to bring out the logical structure of the subject in order to keep its mastery from becoming unnecessarily difficult integrates well with Piaget's ideas. The subject matter should be presented with some sort of an internal logical structure and be related as well as possible to the already existing cognitive structures of the human learner (Martin & Friedberg, 1986; Martin, 1986b).

Montessori's thoughts added three components to WTR. First, she emphasized a multi-sensory, didactic approach to learning. In addition, she believed in natural reinforcement, the rewards learners derive from learning and an internal sense of accomplishment (Martin & Friedberg, 1986). Finally, she was an advocate for writing before reading, an obvious connection to WTR.

In consideration of these ideas, Martin attempted to produce a computer assisted instructional program that included six characteristics:

1. The Alphabetic Principle
2. Phonemic Spelling
3. Self Direction
4. Evidence, Hard Copy
5. Mastery
6. Multi-Sensory Perception

Each of these will be described in length below.

<u>Alphabetic Principle</u>. In general, this simply means that there are letter symbols for spoken sounds. This is the first concept taught in writing to read, and is summarized by Martin as "the alphabet stands for sounds, and . . . words we can speak are the same words when they are written with letters" (Martin & Friedberg, 1987, p. 57). This is an implicit notion for literate adults but is a truly monumental development in perception for children.

<u>Phonemic Spelling</u>. Though many consider WTR to be unique in that it teaches reading through computers,

Martin feels that the truly revolutionary change in his program is the emphasis on phonemes. A phoneme is any of the 42 sounds that are used in the English language. Instead of using 26 letters to write, Martin teaches students the 42 phonemes. This idea was first presented by Godfrey Dewey in his World English Spelling Alphabet. The advantage of phonemes over letters is regularity in spelling. Others attempted to make use of the phonemes. Caleb Gattegno devised a system called Words In Color, which coded writing, matching colors with sounds. Sir James Pitman created the Initial Teaching Alphabet which, in a sense, added "letters" to the alphabet by providing a grapheme for every phoneme. The problem occurred, according to Martin, when the student had to unlearn the color coding or additional graphemes and transfer to the standard alphabetic spelling. To escape this problem, Martin used Dewey's World English Spelling, which consists of the 42 phonemes all written via the use of individual letters, letter combinations, and macron bars. In doing all of this Martin has attempted to accommodate the stated theories of Piaget and Bruner. Piaget's "pre-existing cognitive structures" are satisfied through the use of the phonemes which are more natural than the restrictive 26 letters. Bruner's demand for internal logical structure in fields of study is met through the more logical phonemic rather than standard spelling. To illustrate, using phonemic spelling ocean and sugar would each include the phoneme 'sh' because that sound is present in both words. In the standard spelling of these two words, of course, the 'sh' is produced with an 's' or a 'c' in combination with vowels. Once the student has learned the 42 phonemes, the process of writing occurs in stages via the proposition that whatever one can say one can write. The student speaks the word, decides what sound and therefore what phoneme begins the word, writes the phoneme, decides what sound comes next, writes that phoneme, etc.

Self-Direction. Martin attempted to integrate self direction, the ability of the student to learn without adult intervention, into WTR. He did so through designing the materials in such a way that the sequence of steps for the computer, the work journals, and many of the other stations would be obvious enough to the student that very little teacher input would be necessary.

He has succeeded to a certain extent. Three basic problems remain. The setup of the IBM computer requires an adult. Thus the student could work quite independently for 10-15 minutes but once a disk has run its course, adult intervention is required. Second, while the adult's "interference" in student learning has definitely been reduced, it could be argued that the adult has simply been replaced by the computer, the disadvantages of which have been stated above. Martin counters with the contention, based on anecdotal records of conversations with WTR students, that children do not see the computer as controlling or particularly powerful (Martin & Friedberg, 1986). Nevertheless, the computer is instructing and perhaps adult human intervention is better than computer intervention. Finally, while Martin claims that his system is built partially on the ideas of Piaget, others would disagree that the self-direction he gives would satisfy the requirements of Piaget.

> Jean Piaget emphasized the importance of what he called 'reflective abstraction' for the mental ability of child. A child who is engaging in self-directed learning can reflectively abstract from those activities. That reflective

> abstraction encourages the growth of new mental abilities. . . . When adults intrude on a child's learning, they also interfere with the process of reflective abstraction. . . . Such reflective abstraction, however, is essential for the full realization of a child's cognitive abilities. (Elkind, 1986, p. 636.)

Thus, the actual degree to which WTR is truly self-directive through the design of its materials is questionable. However, Martin also claims that the very foundation of the program is self-directive, due to its emphasis on developing the ability to write before the ability to read:

> We believe that writing is a more powerful act than reading because it is ego centered and gives an outlet to a child's natural urge to speak on paper. A child who write will surely learn to read, but it is not a certainty that a child that learns to read will learn to write. (Martin & Friedberg, 1986, p. 55)

This contention, that writing and reading are so completely similar that the first will automatically lead to the second, has a great deal of face validity but is not a topic of consensus among researchers. In fact, respected authorities in the field differ in their views from the first extreme of believing the tasks are basically one to the second extreme of believing there is no cognitive relationship between the two (Broadley, 1986; Saracho, 1985; Smith, 1985; Squire, 1985; Wagner, 1985). Even though the authorities still disagree, the Language Experience Approach (LEA) and Whole Language Approach are both consistent with Martin's combination of writing and reading. The LEA, in fact, emphasizes the values of the motivational value of students reading stories they have written (Saracho, 1985; Smith, 1985). Its approach was summarized by Henning "as teacher stimulation of writing ideas, student writing, revision, and oral reading of student work" (Henning, 1981, p. 19). In fact, since the newest version of WTR has abandoned the IBM typewriter in favor of the word processor, one of the major disadvantages of LEA, the drudgery of revision and rewriting, has been removed (Smith, 1984). Some computer assisted instruction utilizing the writing-reading relationship has been shown to be effective by research (Heffron, 1986; Henney, 1988; Newman, 1988). Even Martin is willing to admit that there is no one-to-one match between reading and writing and that a different mental function is involved for each (Martin & Friedberg, 1986).

The idea then that Martin has integrated self direction into WTR rests on two assumptions, both of which are challengeable. These two assumptions are that the Computer, Work Journal, and other stations are better examples of independent student learning than traditional methods and that writing and reading are strongly related in the learning process.

<u>Evidence/Hard Copy</u>. This refers to the idea that children benefit from having some sort of tangible evidence of their abstract learning process. This idea is also based on Piaget's cognitive developmental stages. This is accomplished through the Work Journal Station, the Writing Station, and the Make Words Station. Each of these stations will be described at length below. Suffice it to say that these stations enable the child to take home written work or manually manipulate or create letters in class. There is little educational controversy over the need to provide tangible evidence of learning to young children. However, opponents to formal learning at an early age would probably not consider WTR much of a hands-on learning approach. Martin makes no apologies. He is a

firm believer that kindergarten students are ready and excited about learning language skills and even criticizes programs like Head Start for not focusing on these to the extent he would like (Martin, 1969; Martin & Freidberg, 1986). When Martin speaks of tangibles, he means booklets and papers. When proponents of less formal education for young children speak of tangibles, they mean people, animals, and objects in the child's environment.

> Because the world of things, people, and language is so new to infants and young children, they learn best through direct encounters with their world rather than through formal education involving the inculcation of symbolic rules. (Elkind, 1986, p. 631)

This becomes a matter of degree. Because WTR utilizes fewer symbolic rules, it is probably better than traditional reading instruction but worse than the old concept of social kindergartens. Whether he likes it or not, Martin's program has placed him in a position of favoring academic kindergartens because of his implicit preference for WTR's use at the kindergarten level. The opponents of academic kindergarten put forth a laundry list of disadvantages of the formal instruction of young children.

> Those who work with young children tend to believe that the period of early childhood is unique in human development, that it deserves to be protected by adults, and that it is characterized by marked individual differences in rates and styles of growth and learning, requiring sensitive programmatic responses. (Hills, 1987, p. 269)

While such people believe that academics pushed too early will lead to motivational and social problems, it is the intellectual difficulties that they describe that are most important to this study. Pushing students into academic learning before they are ready may lead to a dependence on adults for learning, a loss of reflective abstraction, and a creation of artificial intellectual limitations due to forcing students to work at the stage of concrete operations when they are at sensorimotor or preoperational stages (Cuffaro, 1985; Elkind, 1986). Thus, WTR is risking future intellectual growth but not to the degree that other methods of formal education in kindergarten are doing. Likewise, the degree of self direction in WTR lies somewhere between formal instruction and the experiential instruction of those in favor of more social kindergartens.

Mastery. This concept, borrowed from Benjamin Bloom, is defined by Martin as the student knowing the material and knowing that they know the material. Mastery is determined through the Computer Station and the Work Journal Station. Mastery is accomplished, according to Martin, largely through the interactive nature of the computer, consistent with the research findings that interaction is one of the components that correlates positively with a successful computer assisted instruction program. This interaction occurs at the computer. When the student is instructed to perform a task, the student will know if he has exhibited the correct response because only the correct response will allow him to go on to the next task. An incorrect response will produce no reaction from the computer. There are two exceptions to this. The first are the mastery tests at the end of every three cycle words. A certain number of incorrect responses on any one task on a mastery test will cause the computer to re-introduce the same instructional materials that were supposed to have taught the student in the first place.

The other major exception occurs on the rare occasion when a practice game is exhibited by the computer. This game basically asks the student to type a cycle word before a certain amount of time runs out. Graphics are included. As anyone who has ever played Nintendo will tell you, this is not a high level of interaction. The system is missing out on opportunities to reward the student with written or spoken congratulations, flashes of light, buzzers, etc. Martin's reason for not including such artificial rewards is related to his idea that using and learning language skills is intrinsically rewarding to students and that adding artificial rewards would prove demotivating for future learning.

> In Writing To Read there are no consequences attached to an incorrect response and no praise for correct ones. There are no rebuffs, no pleasing bells or chafing whistles, or visual admonishments on the screen, and there is no cheering either. Errors just do not work. . . . What we've tried to do is remove both the whipped cream and the vinegar from learning. (Martin & Friedberg, 1986, p. 107)

While traditional proponents in operant conditioning may argue against Martin on this point, research on computer assisted instruction may bear out his contention.

> For example, instructional software can motivate learners by providing rewards for successful academic performance, such as an accumulation of points for each correct answer, and it can embed learning activities in an appealing context. While these extrinsic motivational embellishments can sustain student involvement in a particular computer learning activity, can they instill an enduring intrinsic interest in the subject matter or even in the process of learning when these external rewards or punishments are no longer provided? . . . Embellishments may make learning more enjoyable, and this may improve students' attitude toward the subject and their interest in learning more about it independently. But these motivational features may ultimately increase learners' dependency on rewards, distract them from the learning task itself, weaken their perspective, or diminish their attitude toward the

subject matter outside the computer context.
(Krendl & Lieberman, 1988, p. 376)

A last issue for mastery is the extent to which it occurs. Among all of the hubbub of statistics being offered in an attempt to prove the efficacy of WTR, John Henry Martin rises to the occasion and directly offers his own, finding that WTR has little effect on students who are uncommunicative or who have limited vocabularies. The WTR is not an answer to the problem of unenriched home environments; it is not a panacea.

Nevertheless, it does test for mastery and include some interaction, possibly the right amount and possibly too little, to produce that mastery.

Multi-Sensory Perception. The idea implied here is that children learn via many different senses. While schools have tended to concentrate their efforts on the senses of sight and hearing, some children arguably learn better in different ways (Armstrong, 1988). Montessori centered much of her instruction on this ideal. Martin seeks to do the same.

> The research on multi-sensory perception dates back at least 100 years and its findings are significant for the Writing to Read program. The research has clearly shown that when tasks are

> designed to appeal to many senses at the same time children . . . learn more quickly. (Martin & Friedberg, 1986, p. 67)

To implement this, Martin included many different sensory tasks in WTR. The Computer Station requires visual and auditory (speech synthesizers are attached to the computer) learning. The Work Journal Station and the Writing Station include basically visual tasks. The Listening Library Station obviously is an auditory task. But it is the Make Words Station in which students make cycle and related words with sand, pencils, gelatin powder, string, glue, clay, etc. that brings more senses into play. Teachers are encouraged to include creative new materials in this station (Martin, 1986b). While there is little controversy over the benefits of appealing to many senses in a learning task, the question of this station's efficacy remains unaddressed.

Conclusion

Educational software available over the last 20 years has been plagued by a neglect for its relevance and consistency with learning theory. To many, it is seen as little or no improvement over the workbook or dittoed page (Anderson, 1985). John Henry Martin, on the other hand, has obviously attempted to develop a program that springs from sound educational theory. In fact, one could make an interesting case that this application of specific theories of Piaget, Bruner, or Montessori would enable researchers to make practical educational tests of those theories. Software is already in existence which matches each of the major theories of the psychological processes of reading (Mason, 1987). From what was stated above, however, it should also be obvious that one could endlessly argue the match between a particular practical application and a theoretical construct. A more useful approach, then, may be a comparison of WTR to the research-based criteria discussed earlier.

Comparison of WTR and the Criteria of Effective CAI

While the comparison of WTR to research-based criteria for effective CAI programs could be more useful than such theoretical arguments, the results of such a comparison are mixed due to unclear definitions of criteria and questions of what constitutes meeting criteria and what does not.

While WTR definitely goes beyond mere drill and practice, it is impossible to determine whether or not it is consistent with learning theory. Clearly Martin feels WTR is based on such theory but others feel he has misinterpreted the very people he claims as intellectual backers.

On the other hand, Martin attempts to stress the personnel criteria listed above in training sessions and WTR instructions. He clearly intends that WTR instructors will be thoroughly trained (Martin, 1986b; Staff, 1988). Still, there is no guarantee that what Martin and his program recommend will be followed in actual practice.

In terms of intrinsic interest, WTR definitely meets the recommendation for multi-sensory program but is questionable on reinforcement. Since the five WTR stations involve at least three and possibly even five of the major senses, it can definitely be considered multi-sensory, especially since this was one of the five major components of WTR as described by Martin. Martin's view of reinforcement, however, was that it came with self-directed learning rather than extrinsic positive reinforcement. The research, as stated above, is mixed on this question.

In terms of being learning specific, WTR is at best adequate. Interaction is certainly less than it could be, and branching is nonexistent. If, through its monitoring of the student's achievement, the computer determines further instruction is necessary, past instruction is repeated; no new instructional technique is attempted.

The match between WTR and the criteria for a successful CAI program, then, is unclear. Since neither the theoretical nor the criterion-based approach to evaluating WTR will prove workable, an empirical study of the program is necessary.

Analysis of Four Studies on Writing to Read

There are basically four studies relevant to this research into the effects on reading of WTR. The first, "Write first, then read," by J. Wallace, made no attempt at quantifying the effects of WTR on students; it was basically a qualitative study. Wallace visited four Portland, Oregon, schools that were using WTR in kindergarten classrooms. In a typical WTR kindergarten were four adults: the teacher, an aide, the WTR coordinator, and a parent volunteer. The students were very comfortable with all the equipment (computer, typewriter, tape recorder, etc.) and became so involved in it that they required little attention from adults, enabling the adults to spend their time motivating, prompting, and assisting students in higher level thinking skills. Building administrators were quite enthusiastic about the programs though they enumerated several fairly insignificant drawbacks and were quite clear in stating that WTR was no panacea. Wallace did, however, pose two very important questions, both worthy of research though actually fairly difficult to test:

> Given the expense of W.T.R. in personnel, time, hardware and materials, could equal or better results be obtained through other means? If the system turns out to be as effective as claimed, is this a result of the teaching strategy, the particular equipment and programs, or some combination of the two? (Wallace, 1985, p. 137)

But there is also a question that needs to be answered prior to either of these. Is WTR effective? This question has not been adequately answered as of yet.

E. Kirkland (1984) in "Writing to Read: A Computer-based, Language Experience, Writing and Reading System, as Used with Handicapped Children," reported on a more empirical study she conducted with 600 students with language problems ranging from having no written language as a part of their culture to students with learning disabilities and educable mental retardation. She lauds the program as a major advance in reading instruction for all children. But several difficulties arise with her study. First, she gives some information on her results but leaves out any baseline achievement scores or achievement expectations without WTR. Average percentage of improvements ranged from 11% for students with limited English proficiency to 56% for Title I students. But, since she gives the reader no information on what the average percentages of improvement would have been without WTR, the significance of the data is unclear. In addition, Kirkland explains that 14 Title I students tested out of the program because of improved reading achievement scores. But she does not tell how many of the 600 students were in Title I nor how many would have been expected to test out of the program under traditional teaching methods. Again, the data is basically useless. A final source of information Kirkland provides is anecdotal data on individual students. These were not presented under the necessary restrictions of single case designs and so are also unpersuasive. Nevertheless, she does provide a number of recommendations and comments from practicing teachers and administrators on WTR and this could be valuable for the practitioner working with WTR.

A third, and clearly the most persuasive, research design on WTR was done by R. Murphy and L. Appel for the Educational Testing Service. The study was conducted over a two-year period and included over 10,000 students in 28 schools. A formative evaluation was conducted the first year on all of these sites and an achievement-based evaluation the second year in 15 sites. Urban, suburban, rural, large and small schools were all included in this study. The study was actually designed to speak to seven issues concerning WTR including technological feasibility of WTR, overall learning effectiveness, student writing, student reading, student spelling, teacher attitudes, and parent attitudes. Only one of these, reading achievement, has a direct impact on this study. Murphy and Appel made the following conclusion about WTR's effect on reading achievement:

> In Reading, Kindergarten Writing to Read Students Have A Significant Advantage Over Comparison Students. In Grade 1, Writing to Read Students Compare Favorably with Other Students. (Murphy & Appel, 1984, p. 9.4)

The assessment of WTR's effect on student reading involved 4,000 children in 202 kindergarten and first grade classes. Children were pretested and posttested using the California Achievement Tests, the Comprehensive Tests of Basic Skills, Iowa Tests of Basic Skills, the Metropolitan Readiness Tests, and the Stanford Early School Assessment Series (Murphy & Appel, 1984). The basic data provided with the conclusion demonstrated that results did not differ on the basis of sex, race, socioeconomic status, or level of ability. However, the conclusion tends to detract from the full scope of the data's implications. Since a significant difference appeared only in the kindergarten students (the first graders who took WTR "compared favorably" only in that their scores were not lower than the control group's (Murphy & Appel, 1984, pp. 6.9, 6.10), it is necessary to attempt to discern why the positive effects would show up in kindergarten and not first grade. The most likely conclusion is that the control group was receiving no reading instruction or instruction far below the academic level of WTR. Since Murphy and Appel do not speak to the reading instruction given to the control group, it may be assumed that differences were due to the absence or reduced level of reading instruction in the kindergarten control group (Slavin & Madden, 1989). In fact, Murphy and Appel admit in their results that the lack of significant differences between WTR and non-WTR first graders is very possibly due to the fact that first-grade children are actually involved in reading to a greater extent than are kindergarten students. Thus, while the study may have relevant things to say about other facets of WTR, the ETS evalution of the effects of WTR on reading achievement is either stating that the results are unclear or the effects are insignificant.

Collis and two of her colleagues prepared an ex post facto quasi-experimental research design on WTR's impact on reading and writing achievement as well as professional and non-professional attitudes toward WTR. The results were reported in the "Interim Report on the Victoria Installation of Writing to Read." Their study included two schools in which WTR was implemented, one strictly according to WTR instructions and the other in a modified sense. A control school utilized traditional reading and language arts instruction. The study included first graders only and found no statistically significant difference in reading achievement between first-grade students who had been taught with WTR and first-grade students who had been taught with traditional methods (Collis, Ollila, & Muir, 1987). However, in a related study, one of the researchers did find positive results of WTR in writing skills, and that may be important enough to warrant WTR's use (Ollila, 1987). Before the possibility that WTR may increase reading achievement is thrown out, an analysis should still be done between kindergarten students taught with WTR as compared to kindergarten students taught with traditional methods. As Martin has made clear, he prefers that WTR be offered in kindergarten (Martin & Friedberg, 1986).

This study will close four of the gaps in past research. First, a comparison will be made between an academic WTR kindergarten and an academic non-WTR kindergarten. In addition, in an attempt to minimize the possibility that the reading skills improved by WTR are not being tested by standardized reading achievement scores, this study will compare Reading, Language, and Composite scores on the Iowa Tests of Basic Skills. Third, this study will compare these students over a four-year period to see if the differences, if any, will last. Finally, the experimental group in this study will have followed the "Guidelines for the Continuation of Writing To Read After Cycle 10" as recommended by IBM (Martin, 1986b). These guidelines are not mentioned in other research. Hopefully these gaps can be filled by the present study.

Chapter III

DESIGN OF THE STUDY

Defining the Population

As stated in the rationale, the goal of this study was to determine if the WTR program was more effective in teaching reading than traditional methods. Writing to Read was designed for kindergarten and first graders. The kindergartners in question in this study go to school in two school districts eight miles apart in rural, southwestern Iowa. District B implemented the WTR program in the 1986-87 through 1989-90 school years. District A continued to use traditional teaching methods for reading instruction. No attempt was made at random sampling since the students travel through grade levels in basically unchanging cohorts due to the fact that there is normally one and at most two sections of any one grade level. The group of kindergartners in 1986-87 are now in the third grade and so longitudinal comparisons of these groups can also be made, rather than being restricted to comparisons at the kindergarten level only.

Limitations and Delimitations

The basic limitation of this study occurred because of the age of the subjects. First, the students were instructed with WTR as kindergartners and so its impact as an instructional method initiated with first graders was not discussed. However, past studies have demonstrated (Murphy & Appel, 1984) that WTR has a greater impact on kindergartners than on first graders, possibly because traditional reading instruction was often not begun with intensity until first grade. Thus, the comparison was one of WTR reading instruction to little or no reading instruction besides the learning of the ABC's. District B, on the other hand, had an academic kindergarten, utilizing the Ginn series, Readiness Level and Level 1, and materials. These materials involved instruction in recognition of letters and their related sounds and twenty sight words. Second, as stated, these two districts were located in rural southwest Iowa with economies based heavily on agriculture. Generalizing these results to urban or non-midwestern populations may not be appropriate.

In addition to these limitations, the study also has several necessary delimitations. First, reading ability was operationally defined as that ability measured by the Reading Test in the Iowa Tests of Basic Skills (ITBS). Since this test measured reading comprehension for words, pictures, sentences, picture stories, and ability for word attack (Hieronymus & Hoover, 1986), it was possible that WTR's goals were not measured by ITBS reading scores. The WTR Teachers' Manual described the goals of the program as follows:

> Writing to Read is a computer-based instructional system designed to develop the writing and reading skills of kindergarten and 1st grade students. (Martin, 1986b, pp. 1-3)

While the manual also described some of the specific methods by which these skills were taught, it did not clarify which specific skills were intended. Clearly, however, this study was not designed to test WTR's impact on writing skills and this was a further delimitation of the study, but not a critical one since other studies have already researched that question (Ollila, 1987). To improve the fit between the reading skills taught by WTR and the skills tested by ITBS, student scores on Language Skills and overall abilities, as evidenced in the ITBS Basic Composite scores, were also analyzed.

In fact, for comparisons at the kindergarten level, reading comparisons could not be made directly because the reading subtest was not taken by kindergartners except in spring testing. Kindergarten scores, the only data subjected to tests of statistical significance, reflected language and composite achievement only. Reading scores for later grade levels will, however, were compared longitudinally.

Operational Definitions

In this study, there were basically two variables, the independent and the dependent. The independent variable was the particular method of reading instruction, either WTR or traditional methods. The dependent variable was reading ability. Before the methodology of this study was discussed further, it was first necessary to operationalize each of these variables so that a clear and consistent understanding of each could be discerned.

1. Reading ability--Student score on the ITBS reading test. Language Test Scores and Basic Composite Test Scores were also analyzed.

2. Reading Instruction through WTR--Kindergarten student instruction through the five learning stations

of the IBM WTR Program for sixty minutes/day for the second semester of an academic year.

3. Reading Instruction through traditional methods--Kindergarten student reading instruction through phonics, basal readers, and workbooks (Ginn Reading Series), occurring fifty to sixty minutes/day for the second semester of an academic year.

Instrumentation

As described above, the source of data for this study were the ITBS reading, language, and composite scores from annual testing of students.

Validity of ITBS

Again, it was difficult to discern how well the ITBS measured reading skills taught by WTR since WTR gave no specific description of skills taught. However, this was reasonably provided for by the inclusion of Reading, Language, and Composite scores in the analysis. If the differences in scores between District B and District A correlate with WTR instruction, a positive result of some kind would have been found.

In terms of the validity of the test construction by ITBS test designers, the ITBS "Manual for School

Administrators," (source for all validity, liability, and stability data herein) page 9, claimed that "All of the commonly used principles in the validation of test content have been applied in the preparation of individual test items." The manual, p. 74, went on to describe the following criteria, in no particular order, for determining item selection:

1. Placement and emphasis in current instructional materials, including textbooks.
2. Recommendations of "authority," including statements of methods specialists, national curriculum committees, and writers of methods books in subject matter areas.
3. Continuous interaction with users including discussions of needs and priorities, criticisms, and suggestions. Feedback from teachers and administrators has resulted in changes and improvements of many kinds.
4. Frequency of need or occurrence (The American Heritage Word Frequency Book, Carroll et al. (114), The Living Word Vocabulary, Dale and O'Rourke (115), and Basic Reading Vocabularies, Harris and Jacobson (119) are

examples) and social utility studies in various curricular areas.

5. Studies of frequency of error, particularly in language and mathematics, as determined from research studies and data from item tryout.
6. Importance or cruciality. This critical judgmental criterion may involve frequency, seriousness of error or seriousness of social penalty for error, authoritative judgment, instructional trends, public opinion, etc.
7. Independent reviews by professionals from diverse cultural groups for fairness and appropriateness of content for pupils of different backgrounds: geographic, urban/rural, sex, race, etc.
8. Empirical studies of differential item performance to detect possible item bias. Examples are studies by Coffman (9), Haebara (24), Harris and Hoover (25), Hoover and Kolen (28), Laksana (33), Loyd (40), Martin and Hoover (45), Plake and Hoover (56, 57), Plake, et al. (59), and Qualls (61).
9. Technical characteristics of items relating to content validity; results of studies of item

> characteristics of various types; appropriateness of content for special types of pupils; studies of inter-relationships and uniqueness of tests; etc. Examples are the studies of Allen et al. (1), Feldt (196), Forsyth and Spratt (255), Hildebrand and Hoover (157), Lewis (34), Long (206), Martin (43), Meyen and Hieronymus (48) Monroes (163), Oehmke (277), Santos (67), and Schreiner et al. (170), among others. (Hieronymus & Hoover, 1986)

Reliability of ITBS: The "Manual for School Administrators" spoke also to the reliability of the tests.

> Reliability in the description of each individual pupil was an important consideration in constructing the tests. Each test was made long enough to provide a sound basis for diagnosing relative strengths and weakness of individual pupils and assessing changes in performance from year to year. (Hieronymus & Hoover, 1986, p. 9)

The Manual went on to more specifically describe the methods used to test reliability:

Two methods of estimating reliability were used to obtain the data provided in the following sections. The first method employed internal consistency estimates through the use of Kuder-Richardson Formula 20 (K-R 20) procedures. Reliability coefficients derived by this technique were based on data from the entire national standardization sample.

The second method provided estimates of equivalent- forms reliability coefficients for Forms G and H from data obtained from the administration of previous equivalent Forms 7 and 8 adjusted for differences in test length and variability of grade-equivalent score distributions. (Hieronymus & Hoover, 1986, p. 91)

From these two methods, the data provided demonstrated mean reliability coefficients at the levels shown in Table 1.

Table 1

Internal Consistency Reliability For Grade Equivalent Scores: Fall Testing

Grade	Reading	Language	Basic Composite
Kindergarten	-	.767	.941
First Grade	.917	.771	.930
Second Grade	.918	.933	.964
Third Grade	.910	.953	.963

Source: Hieronymus and Hoover, 1986, p. 97.

Stability of ITBS. Stability coefficients for ITBS were based on equivalent forms testing and longitudinal studies. Variations were due to different stabilities at different grade levels. The appropriate coefficients for equivalent forms testing are shown in Table 2.

Procedures Utilized in This Study

1. The experimental treatment of instructing the District B kindergartners with WTR during the 1986-87--1989-90 school years.

2. The control treatment of instructing the District A kindergartners with traditional methods during the same years.

Table 2

Stability Coefficients Based on Fall-Spring Comparisons

Grade	Reading	Language	Basic Composite
Kindergarten	-	.659	.837
First Grade	.646	.662	.838
Second Grade	.776-.781	.819	.886-.897
Third Grade	.763-.766	.767-.794	.863-.883

Source: Hieronymus and Hoover, 1986, p. 105.

3. The testing of both groups during those years with ITBS.

4. A baseline was determined for each of the four districts through kindergarten ITBS testing, and a seven-year analysis of past cohorts before WTR to compare the average backgrounds of students in Districts B and A.

5. Reading, Language, and Basic Composite means were compared for each same-year cohort of District B and A.

6. The difference at the kindergarten-first grade level were established statistically through the use of analysis of covariance.

7. The remaining differences were descriptively analyzed and interpreted as to their relationship to the WTR program. If there was no difference, assuming all other variables had been reasonably accounted for, WTR was judged as being no better than traditional methods. If there was a difference in any of the three ITBS scores, longitudinal comparisons of reading, language, and composite scores were explained and discussed.

Data Analysis

The data analysis was done according to points 5-7 directly above, conducting an analysis of covariance of all kindergarten language and composite scores during the four-year period, using a .05 significance level. The following data was used

Variables

Student #:
District #:
Sex:

Reading Score*:
Kindergarten:
First Grade:
Second Grade:
Third Grade:

Language Score*:
Kindergarten:
First Grade:
Second Grade:
Third Grade:

Basic Composite Score*:
Kindergarten:
First Grade:
Second Grade:
Third Grade:

*All Scores are grade equivalency scores.

Also, a seven-year analysis of past classes included variables for Reading, Language and Basic Composite in the third grade to create a baseline.

Design

As stated earlier, the data collected for this study were analyzed in two ways. First, ITBS language and composite scores were analyzed at the kindergarten and first grade levels with tests of covariance. If statistical significance was found, a longitudinal comparison was made of the reading, language, and composite scores for kindergarten through third-grade scores, where possible.

Analysis of Covariance

Since random assignment to treatment and non-treatment groups was impossible, this study used an ex post facto, quasi-experimental, cohort design. It was diagrammed as such:

	Kindergarten Scores	Treatment	1st Grade Scores
District A Students	O_1		
			O_2
District B Students	O_1		
		X	O_2

Post hoc Comparisons

These comparisons were done to discern the likelihood of differences continuing through later school grades and were demonstrated through the use of graphs and descriptive statistics, not through the use of inferential statistics.

Controlling for Threats to Internal Validity

Selection

Since random sampling was not possible, it was necessary to pre-test to demonstrate that reading achievement, or at least academic achievement generally, was similar in the two groups. While there was not likely to be a great deal of difference between two groups of kindergarten children living eight miles apart in rural southwestern Iowa, pre-testing was nevertheless done through kindergarten ITBS and a seven-year analysis of pre-WTR cohort groups in the two districts. The analysis of covariance compensated for possible differences by statistically equating the groups relative to the pretest before analyzing the differences between means on the post-tests. The post hoc comparisons included initial scores from each group and historical baseline scores of the treatment group. In addition, any child retained during the four years of this study and any child who did not go to school continuously in one district or the other was not included in the analysis.

Experimental Mortality

A few children did move during the four years of this study and were thus removed from the analysis. The number of children so affected was minimal and so should have no impact on the study.

Statistical Regression

Since no score-based grouping was done, this was not a relevant threat to validity in this study.

However, extreme scores in kindergarten were somewhat present, and this fact should be noted by the reader.

Instability

Possible instability in the instrument (ITBS) has already been dealt with in that section of the paper. Instability among individual test takers can be assumed to occur among students in Districts B and A at a compensating rate since there is no reason to suspect that one district's students would produce unstable test scores at a higher level than the other. In addition, the researcher observed each of the teachers involved and found that each followed testing instructions fairly closely.

Pre-testing

While the relevant pre-test (Kindergarten ITBS) could have affected students' later learning of reading and later student ITBS scores, this pre-testing occurred for every student in the treatment and non-treatment groups and so should not have had discriminating effects on either group.

Expectancy

While students in District B were aware of the WTR program in their schools, it was not presented to them as an experiment since the idea for the experiment occurred after the treatment. If the novelty of the program did produce improved results, this novelty would have worn off after the first or second year and this trend would then present itself in the post hoc data analysis.

History

If such extraneous events did occur during the 4 year analysis, this would have been demonstrated by a change in results between observations in the groups with more than one observation. Thus, an irregular decline or increase in scores would have occurred for one of the many groups for one year.

Maturation

Maturation would have affected reading achievement significantly. However, this was taken into account by using annual growth in grade equivalency.

Hypothesis

Three null hypotheses were tested through the use of the analysis of covariance. These were:

Null Hypothesis 1: No statistically significant difference in first grade ITBS language subtest score means exist between students instructed as kindergartners in reading through the IBM WTR program for sixty minutes per day for one semester and students instructed as kindergartners in reading through traditional methods for a similar amount of time.

Null Hypothesis 2: No statistically significant difference in first grade ITBS composite score means exist between students instructed as kindergartners in reading through the IBM WTR program for sixty minutes per day for one semester and students instructed as kindergartners in reading through traditional methods for a similar amount of time.

Null Hypothesis 3: Mean score differences between District A and District B groups for reading, language, and composite scores will lessen with time.

Chapter IV

ANALYSIS OF THE DATA

The purpose of this study was to investigate the relationship between the IBM Writing to Read Program and student reading skills, as measured by several scores on the Iowa Tests of Basic Skills. Since it was possible that different skills were taught by the WTR Program than were measured specifically by the ITBS test for reading, data was also collected on the ITBS Language Test and Composite Score. The first two hypotheses of this study were that WTR would lead to no statistically significant differences on the language and composition scores. Hypothesis 3 will be analyzed descriptively. This chapter will present the results of the analysis of the ITBS data and the hypotheses will be accepted or rejected, accordingly.

The IBM Writing to Read Program had been implemented in District B for four years and had been utilized by the following cohorts:

District B 1989-90 Third Graders

District B 1989-90 Second Graders

District B 1989-90 First Graders

District B 1989-90 Kindergartners

The following control group cohorts had been instructed utilizing traditional curriculum:

District A 1989-90 Third Graders

District A 1989-90 Second Graders

District A 1989-90 First Graders

District A 1989-90 Kindergartners

Each grade's scores were presented in terms of Iowa Grade Equivalency (IGE) scores. These scores presented student performance in terms of grade levels with a standard measurement of one-tenth of a year's growth. Scores were normed using Iowa students (Heironymus & Hoover, 1986). These scores were used rather than percentiles since percentiles do not clearly show student or class growth. For example, a third grader doing beginning sixth grade work would be shown as a 6.0 in Iowa Grade Equivalency and as a 99 in percentile rank. Once he enters fourth grade, now doing beginning seventh-grade work, he would be shown as a 7.0 in Iowa Grade Equivalency but still as a 99 in percentile rank. Changes in academic abilities were thus blurred by percentile ranks. The advantages of utilizing the I.G.E. were clear.

The I.G.E. comparisons, through analyses of covariance using grouped kindergarten and first grade scores, were conducted for language and composite scores in the first section of the data analysis. In the second section of the data analysis, longitudinal comparisons of District A non-treatment scores, District B treatment scores, and District B historical baseline scores were made. Both sections include the following: Statement of the null hypothesis, Summary tables of the statistical treatment of the data or graphic representations of the data, Narrative, and Discussion of the null hypothesis.

This first analysis dealt with the first two hypotheses through an analysis of covariance. The analysis of covariance for null hypothesis 1 produced the data in Table 3.

Since the value of F for district effects did not meet or exceed the critical value at .05, it was necessary to fail to reject null hypothesis 3. It was not possible to assume that the means of the two groups were different. Writing to Read was not associated with higher first grade language scores.

The analysis of covariance for null hypothesis 2 produced the data in Table 4.

Table 3

Language Scores Analysis of Covariance

Sources of Variation	Sum of Squares	DF	Mean Square	F Value	Sign. of F Value
1. Covariate:					
Kindergarten Language Score	10.294	1	10.294	8.200	0.005
2. Main Effect:					
District	0.303	1	0.303	0.242	0.624
3. Residual	136.827	109	1.255		
4. Total	147.424	111	1.328		

Covariate:	Raw Regression Coefficient:
Kindergarten Language Scores	0.314

Cell Means

	N:	Mean:
Total Population	112	1.92
District A (Non-treatment)	42	1.83
District B (Treatment)	70	1.97

Table 4

Composite Scores Analysis of Covariance

Sources of Variation	Sum of Squares	DF	Mean Square	F Value	Sign. of F Value
1. Covariate:					
Kindergarten					
Comp. Score	19.626	1	19.626	80.458	0.000
2. Main Effect:					
District	4.033	1	4.033	16.535	0.000
3. Residual	26.588	109	0.244		
4. Total	50.248	111	0.453		

Covariate:	Raw Regression Coefficient:
Kindergarten Composite Scores	0.767

Cell Means

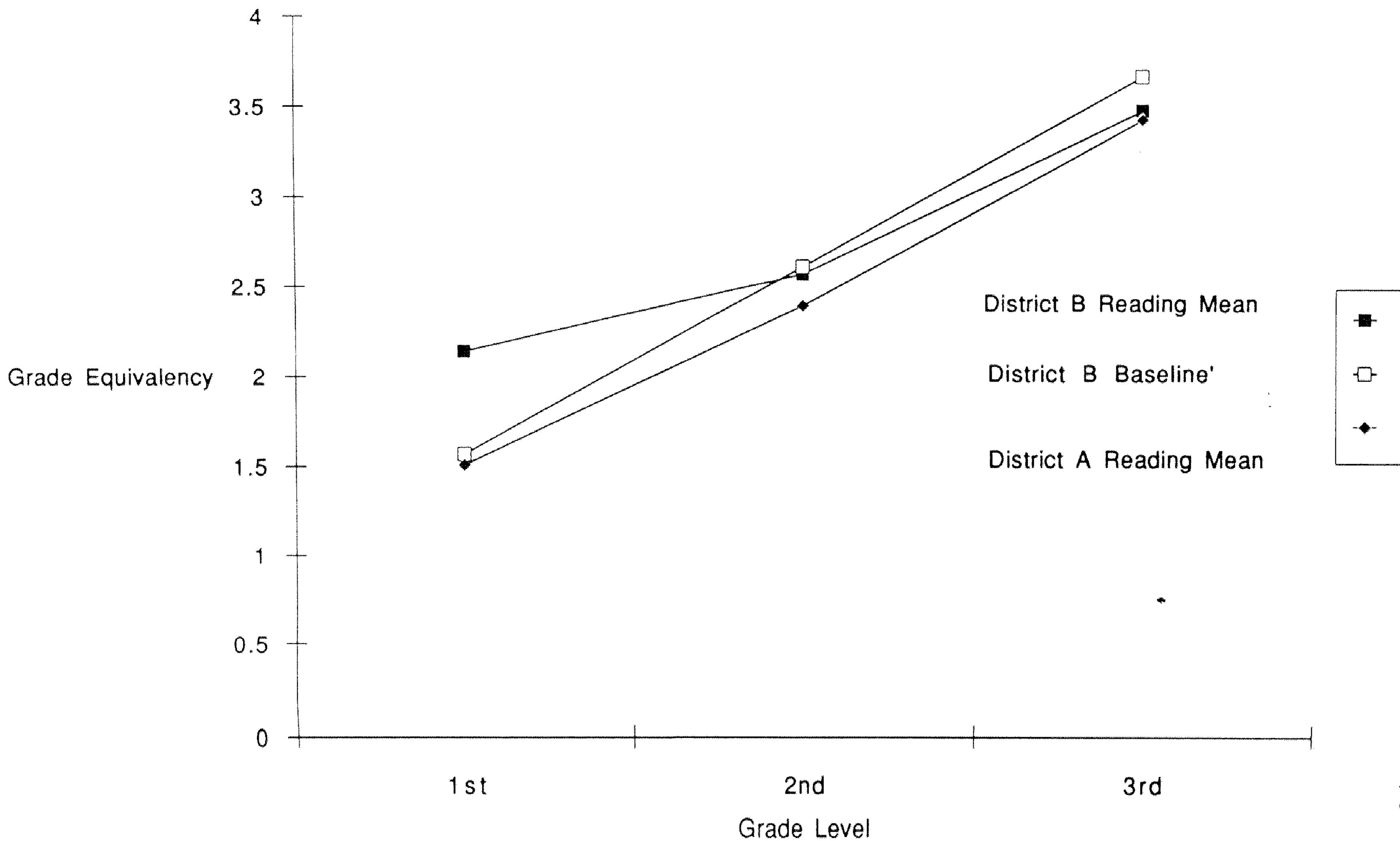
	N	Mean
Total Population	112	1.80
District A (Non-treatment)	42	1.51
District B (Treatment)	70	1.97

In this case, a level of significance at the .05 level was attained. Thus, null hypothesis 1 was rejected. The mean of the treatment group was statistically significantly different (in this case, higher) than the mean of the non-treatment group. This conclusion meant, however, only that the treatment was associated with higher composite scores on the ITBS in the first grade. The association between the treatment and reading, language, and composite scores in later grades remained. That was the subject of the analysis of hypothesis 3.

To repeat, hypothesis 3 stated: Mean score differences between District A and District B groups for reading, language, and composite scores will lessen with time. One of the typical results of instructional programs aimed at the earlier grades has been immediate, drastic increases in achievement followed by a levelling off towards the mean of untreated groups. Often no difference, statistical or practical, can be perceived by third grade. Therefore, the following graphs (Figures 1-3) were developed as descriptive investigations of this phenomenon for Writing to Read.

Figure 1 presents the reading subtest data for the treatment group (District B), for District's B reading baseline, computed as an average of the seven years previous to the introduction of WTR, and for the non-treatment group (District A). The treatment group's score, 2.14, offers evidence of the

Figure 1: Reading Mean Scores



...re 2: ...guage ... Scores

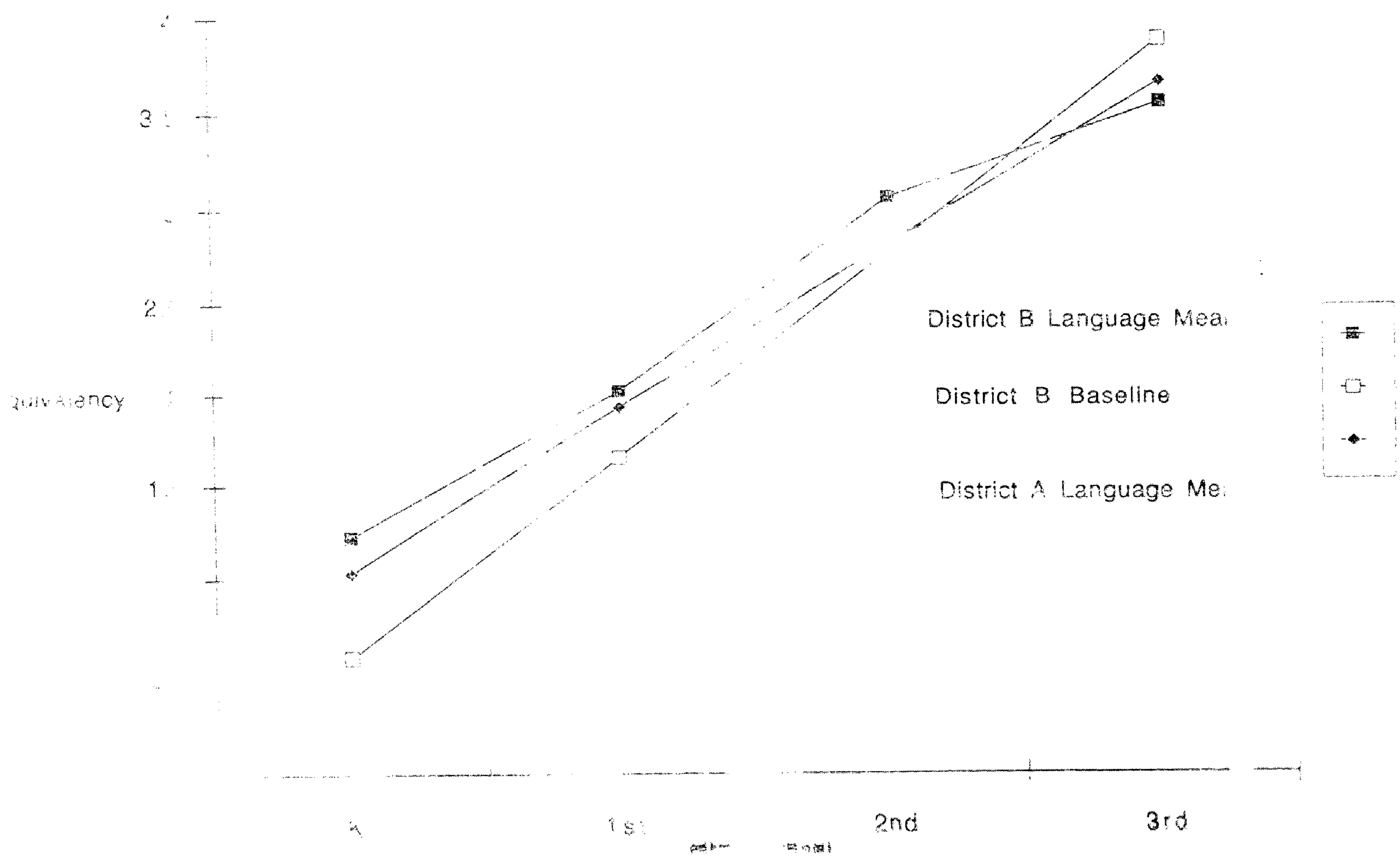
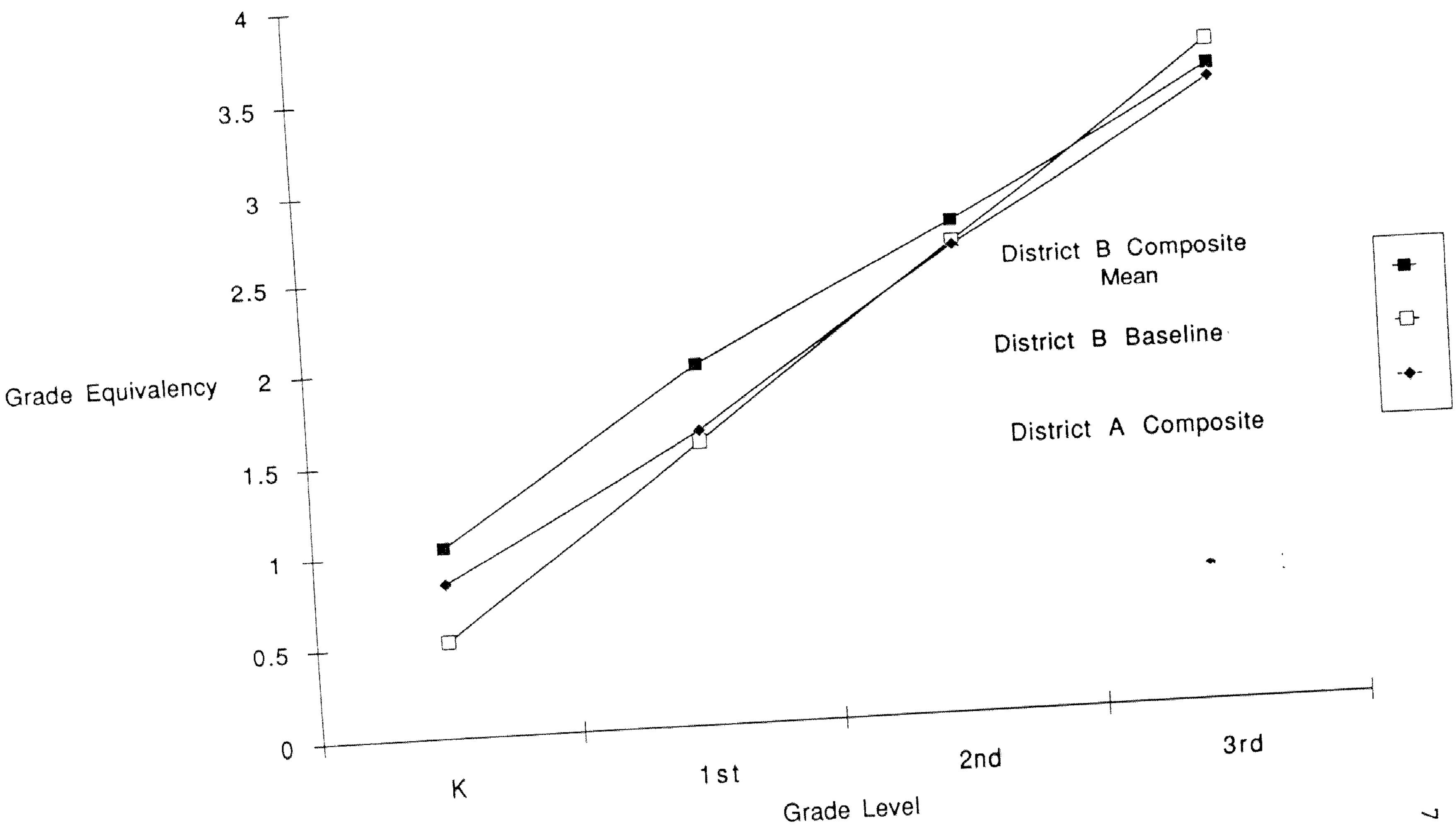


Figure 3: Composite Mean Scores



effectiveness of WTR. (Comparisons are offered initially at the first grade in reading because students do not take the reading subtest on the ITBS until they have reached that grade.) District B out-scored District A by slightly more than six-months reading growth. These are the type of results that have backed up exaggerated claims of educational benefits of numerous programs in the past. As the years pass, however, the difference between the two districts' scores dwindled to .05, less than one month of school growth. In addition, District B had fallen below its reading baseline.

Figure 2 reveals similar results. At the kindergarten level, the treatment group is at a 1.22 grade equivalency, nearly two months ahead of District A's 1.03 and over half a year ahead of the baseline's 0.59. By third grade, however, not only does the gap narrow, District B scores actually fell below both District A's scores and baseline scores. District B trailed District A by one month.

Figure 3 represents the composite scores of the three groups of data. As before, District B was well ahead (1.04 compared to 0.84) of District A and its own baseline (1.04 compared to 0.52). By 3rd grade, however, it had fallen two months below its own baseline and exceeds District A by less than one month.

A full listing of mean scores for the three groups is listed in Tables 5-7.

Table 5

Reading Mean Scores

	District B	District B Baseline	District A
Kindergarten	No Test	No Test	No Test
First Grade	2.14	1.57	1.51
Second Grade	2.57	2.61	2.39
Third Grade	3.47	3.66	3.42

Table 6

Language Mean Scores

	District B	District B Baseline	District A
Kindergarten	1.22	0.59	1.03
First Grade	2.02	1.65	1.93
Second Grade	3.06	2.78	2.82
Third Grade	3.55	3.88	3.66

Table 7

Composite Mean Scores

	District B	District B Baseline	District A
Kindergarten	1.04	0.52	0.84
First Grade	1.97	1.55	1.61
Second Grade	2.71	2.59	2.57
Third Grade	3.49	3.62	3.42

The most important of these descriptive statistics is the composite score. At the first grade level, the difference between District B (treatment) and District A (non-treatment) means was found to be statistically significant. By the third grade, however, the District B mean exceeded the District A mean by .07, less than one month. From this, it can be concluded that it is necessary to fail to reject null hypothesis 3.

Chapter V

SUMMARY, CONCLUSIONS, DISCUSSION, AND RECOMMENDATIONS

Summary

The IBM Writing to Read program has been offered as a promising utilization of computer-assisted instruction in the teaching of reading. Designed to be used at the kindergarten or first grade level, it uses a combination of computer technology and phonemic spelling to teach children how to read in a way significantly different than traditional educational methods. Past studies had shown significant results in some, but certainly not all, skill areas at the kindergarten and first grade levels. What was missing in these studies was a longitudinal approach to the effects of Writing to Read and a more comprehensive analysis of the skills developed. This study has attempted to fulfill these needs. It has provided a longitudinal approach by descriptively analyzing the effects of the Writing to Read program offered to kindergartners on students in kindergarten through third grade. It has offered a more comprehensive analysis by including reading, language, and composite scores on the Iowa Tests of Basic Skills. Comparisons of the experimental group scores were made to a control group in another school district and to the historical baseline of the same district. By making these comparisons, it was hoped that the effects of Writing to Read could be statistically demonstrated. Therefore three null hypotheses were offered:

Null Hypothesis 1: No statistically significant difference in first grade ITBS language subtest score means exist between students instructed as kindergartners in reading through the IBM WTR program for sixty minutes per day for one semester and students instructed as kindergartners in reading through traditional methods for a similar amount of time.

Null Hypothesis 2: No statistically significant difference in first grade ITBS composite score means exist between students instructed as kindergartners in reading through the IBM WTR program for sixty minutes per day for one semester and students instructed as kindergartners in reading through traditional methods for a similar amount of time.

Null Hypothesis 3: Mean score differences between District A and District B groups for reading, language, and composite scores will lessen with time.

Conclusions

1. Practically significant increases in first grade reading, language and composite scores were recorded by students who had been taught through IBM's Writing to Read Program.

Statistically significant increases were recorded only for composite scores. This conclusion agreed with other studies which recorded increases in skills at the early grades. In this study, these increases were more pronounced than in other studies. The ramifications of these increases are elaborated in the following conclusions.

2. By the third grade, scores recorded by students taught via Writing to Read as kindergartners were not significantly different from similar students taught through traditional methods in the experimental or baseline groups.

The improved scores in the early grades levelled out by the third grade.

3. It is unlikely that the computer-assisted component of the Writing to Read Program had even the short-term effects demonstrated in the early grades.

The truth of this conclusion was found in the data analysis of the kindergarten scores. The experimental group outstripped the control and baseline groups before the computer component had even been used. The preliminary work in familiarizing students with letters and their sounds in the first semester of kindergarten had already produced the dramatic increases in scores, increases which had begun to level out by first grade. Essentially, the reading instruction was presented to the students earlier than it had been before that time and earlier than it was being presented to the control group. (This was also the reason an analysis of covariance was conducted for kindergarten and first grade scores.) This early academic instruction in kindergarten was the likely source of the kindergarten and first grade score increases. Due to instruction simply occurring earlier than before with no identifiable additional instruction later, the early increases did not translate into higher scores in the later grades since that instruction would have occurred by the time those students were in those later grades. The IBM Writing to Read Program appeared to be artificially increasing scores by causing instruction to occur earlier. Though Murphy and Appel did not reach this conclusion, their data bears out this conclusion. According to their data, kindergartners instructed with Writing to Read had significantly increased scores while first graders did not (Murphy & Appel, 1984). A persuasive explanation for this is that normally kindergartners would not have received this amount of reading instruction while first graders would have. It is not any particular component of Writing to Read but simply instruction offered earlier.

4. Third grade score means in the experimental group were slightly lower than could have been expected by historical averages but not significantly lower.

Some researchers have asserted that early academic instruction will produce an increase in the number of students who experience academic "burnout." They feel that early gains are superficial and fleeting while later negative effects may be serious and permanent (Gallagher & Coche, 1987; Hatch & Freeman, 1988;

Elkind, 1986; Hills, 1987). Unfortunately, this study has no statistical evidence to add to that controversy.

Recommendations

Three recommendations were offered as a result of this study. The first was a practical recommendation to educators considering the inclusion of Writing to Read into their curriculum. The other two recommendations were for further research along lines similar to this study.

1. The IBM Writing to Read Program was an effective method of increasing student test scores in the early elementary grades in the short term. It did not produce improved scores in later grades. No study, including this study, has demonstrated long-term positive results of the Writing to Read Program. The possibility still exists that later scores fall off because later curriculum fails to capitalize upon skills learned earlier through Writing to Read. The idea that Writing to Read was simply offering instruction earlier rather than better, however, seems a more logical and elegant explanation. Therefore, the Writing to Read Program should not be purchased with the intent of improving student reading skills in the long term.

2. Three different testing areas were analyzed in this study: reading, language, and composite. The composite score had been partially reduced into its relevant component parts by the analysis of the reading and language scores. The reading score had no subtest areas. The language scores, however, were made up of the spelling, capitalization, punctuation, and usage subtests. Early increases in language scores may have been a result disproportionately of one or two of these subtests. Since spelling, capitalization, and punctuation were stressed by traditional language instruction and usage stressed by Writing to Read, it would have been enlightening to see what Writing to Read's impact on each of these subtests was. Is the phonemic method of reading instruction hazardous to spelling? Is the phonemic method of reading instruction beneficial for usage skills? These are assertions made frequently by practitioners but which may or may not have evidence in research. Studying these questions could produce conclusions with direct relevance to Writing to Read and other methods of reading instruction. Research on these questions through the Writing to Read Program is necessary.

3. In conclusion number 3, the possibility of early academic instruction producing student burnout and lower scores in the long term was discussed. The addition of further years of ITBS testing on these two groups would give a clear indication of whether or not the insignificantly lower scores in the experimental third grade group were truly insignificant or part of an emerging trend. As these students become fourth and fifth graders, will their scores continue to decline relative to the control and baseline groups? Will these declines reach a level of statistical significance? If they do, one possible explanation is that this early academic instruction has produced the type of burn-out that some researchers have predicted. If they do not, it is clear that the Writing to Read Program does not produce this type of burn-out and possibly that this burn-out is not a real phenomenon. Continuation of this research through the collection of ITBS data on all students who have taken Writing to Read instruction or who serve as their counterparts in the control group should, therefore, be done.

REFERENCES

Anderson, J. (1985). Writing and learning with microcomputers. In J. M. Ewing (Ed.), _Reading and the new technologies. Proceedings of the Annual Course and Conference of the United Kingdom Reading Association_ (pp. 96-107). Dundee, Scotland: Heineman Educational Books. (ERIC Reproduction Service No. ED 278 944)

Anderson, J. (1988). Computers and the reading teacher: An Australian perspective. _The Reading Teacher_, _41_, 698-700.

Argento, B. J. (1980). _Alternative education models--Preliminary findings of the Job Corps educational improvement effort. Education and training approaches. Youth knowledge development report 5.2_. Report No. CEO2-9-977. Washington, D.C.: Office of Youth Programs, Employment and Training Administration, Department of Labor.

Balajthy, E. (1984). Reinforcement and drill by microcomputer. _The Reading Teacher_, _37_, 490-494.

Balajthy, E. (1985). Microcomputer activities which encourage the reading-writing connections. Paper presented at the annual meeting of the Keystone State Reading Association, Erie, PA. (ERIC Document Reproduction Service No. ED 274 955)

Balajthy, E. (1987a). What does research on computer-based instruction have to say to the reading teacher? Reading Research and Instruction, 27, 54-65.

Balajthy, E. (1987b). Design and construction of computer-assisted instructional material: A handbook for reading/language arts teachers. New York. (ERIC Document Reproduction Service No. ED 285 131)

Balajthy, E. (1988). Computers and instruction: Implications of the rising tide of criticism for reading education. Reading Research and Instruction, 28, 49-59.

Barber, B. (1982). Creating BYTES of language. Language Arts, 49, 472-475.

Blair, T. R. (1986). Microcomputers: Another false prophet? Reading Research and Instruction, 26(1), 58-61.

Blanchard, J. S. (1980). Computer-assisted instruction in today's reading classrooms. Journal of Reading, 23, 430-434.

Bork, A. (1986). Let's test the power of interactive technology. Educational Leadership, 43(6), 36-37.

Bowker, P. (1988). Classroom-based computer assisted learning: Observations, implications and reservations. Support for Learning, 3(1), 44-48.

Bradley, V. N. (1985). Computers and reading instruction. In L. B. Gambrell & E. M. McLaughlin (Eds.), New directions in reading: Research and practice. 1985 yearbook of the State of Maryland International Reading Association (pp. 1-11). Maryland: International Reading Association, Maryland Council.

Brandon, P. R. (1988). Recent developments in instructional hardware and software. Educational Technology, 28(10), 7-12.

Broadley, K. (1986). Past practice and possibilities with computers. Australian Journal of Reading, 9(1), 41-50.

Burnett, J. D., & Miller, L. (1984). Computer assisted learning and reading: Developing the product or fostering the process. _Computer Education_, _8_(1), 145-150.

Clariana, R. B., & Schultz, C. W. (1988). _Computer assisted instruction at St. Anne's School: The second year._ (Report No. SE05-0-161). Paper presented at the annual meeting of the Mid-South Educational Research Association, Louisville, KY. (ERIC Document Reproduction Service No. ED 301 442)

Collis, B., Ollila, L., & Muir, W. (1987). _Interim report on the Victoria installation of Writing to Read_. Publication No. 11. Victoria, B.C.: University of Victoria--IBM Canada Software Engineering/Education Cooperative Project.

Colorado, R. J. (1988). Computer-assisted instruction research: A critical assessment. _Journal of Research on Computing in Education_, _20_, 226-233.

Cooperman, K. S. (1985). An experimental study to compare the effectiveness of a regular classroom reading program to a regular classroom reading program with a computer assisted program in reading comprehension skills in grades two through four

(Doctoral dissertation, The American University). Dissertation Abstracts International, 46, 12234A.

Cuffaro, H. K. (1985). Microcomputers in education: Why is earlier better? In D. Sloan (Ed.), The computer in education: A critical perspective (pp. 21-30). New York: Teachers' College Press.

Dudley-Marling, C. C. (1985). Microcomputers, reading, and writing: Alternatives to drill and practice. The Reading Teacher, 38, 388-391.

Edwards, J., Norton, S., Taylor, S., Weiss, M., & Dusseldorp, R. (1975). How effective is CAI? A review of the research. Educational Leadership, 33(2), 147-153.

Elkind, D. (1986). Formal education and early childhood education: An essential difference. Phi Delta Kappan, 67, 631-636.

Fletcher, J. D., & Atkinson, R. C. (1972). Evaluation of the Stanford CAI Program in initial reading. Journal of Educational Psychology, 63, 597-602.

Gallagher, J. M., & Coche, J. (1987). Hothousing: The clinical and educational concerns over pressuring young children. Early Childhood Research Quarterly, 2, 203-210.

Gentile, J. R. (1967). The first generation of computer-assisted instructional systems: An evaluative review. AV Communication Review, 15(1), 23-52.

Hall, K. A. (1982). Computer-based education. In Encyclopedia of educational research (5th ed.) (pp. 353-367). New York: Free Press.

Harris, C. D. (1985). Evaluation of the TSC Dolphin computer assisted instructional system in the Chapter I program of the District of Columbia Public Schools. Final report 85-9. Report No. IRO1-2-081. Alexandria, VA: Human Resources Research Organization. (ERIC Document Reproduction Service No. ED 270 080)

Hatch, J. A., & Freeman, E. B. (1988). Who's pushing whom? Stress and Kindergarten. Phi Delta Kappan, 70, 145-147.

Heffron, K. (1986). Literacy with the computer. Reading Teacher, 40, 152-155.

Henney, M. (1988). Reading and writing interactive stories. Computing Teacher, 15(8), 45-47, 60.

Henning, D. G. (1981). Input: Enter the word-processing computer. Language Arts, 58(1), 18-22.

Hieronymus, A. N., & Hoover, H. D. (1986). Manual for school administrators: Iowa Tests of Basic Skills. Chicago, IL: Riverside Publishing (Prepared at the University of Iowa).

Hills, T. W. (1987). Children in the fast lane: Implications for early childhood policy and practice. Early Childhood Research Quarterly, 2, 265-273.

Kenneke, L. J., & Suzuki, W. N. (1981). Promising practices in Oregon career and educational vocation. Report No. CEO2-9-644. Salem, OR: Oregon State Department of Education, & Corvallis, OR: Oregon State University Vocation-Technical Education Unit. (ERIC Document Reproduction Service No. ED 205 701)

Kirkland, E. R. (1984). Writing to Read: A computer-based language experience, writing and reading system, as used with handicapped children. Paper presented at the annual meeting of the Western Regional Reading Conference of the International Reading Association, Reno, NV. (ERIC Document Reproduction Service No. ED 248 480)

Krendl, K. A., & Lieberman, D. A. (1988). Computers and learning: A review of recent research. Journal of Educational Computing Research, 4, 367-389.

Leton, D. (1984). The use of computer-automated reading in reading instruction. Psychology in the Schools, 21, 512-515.

Litman, G. H. (1973). CAI in Chicago. Paper presented at the Association for Educational Data systems annual convention, New Orleans, LA. (ERIC Document Reproduction Service No. ED 087 423)

Martin, J. H. (1969). Kaleidoscope for learning. Educational Technology, 52(25), 76-77, 86.

Martin, J. H. (1986a). Developing more powerful educational software. Educational Leadership, 43(60), 32-34.

Martin, J. H. (1986b). Writing to read teacher's manual (Program manual). Boca Raton, FL: International Business Machines Corporation.

Martin, J. H., & Friedberg, A. (1986). Writing to read. New York: Warner Books.

Mason, G. E. (1984). The micro can connect home, school, and community--but it must be read. Paper presented at the annual meeting of the South Carolina Council of the International Reading Association, Columbia, SC. (ERIC Document Reproduction Service No. ED 245 194)

Mason, G. E. (1987). The relationship between computer technology and the reading process: Match or misfit? The Computer in Reading and Language Arts, 4, 15-23.

Murphy, R. T., & Appel, L. R. (1984). Evaluation of the Writing to Read instructional system, 1982-1984. Princeton, NJ: Educational Testing Service.

Neufeld, H. H. (1982). Reading, writing and algorithms: Computer literacy in the schools. Paper presented at the annual meeting of the Claremont Reading Conference, Claremont, CA. (ERIC Document Reproduction Service No. ED 211 959)

Newman, J. (1988). Online: Write your own adventure. Language Arts, 65, 329-337.

Obertino, P. (1974). The PLATO reading project: An overview. Educational Technology, 14(2), 8-13.

Ollila, L. (1987). A comparison of the effectiveness of the computer-based Writing to Read program with respect to their impact on the development of writing skills at the grade 1 level. Unpublished master's thesis, University of Minnesota.

Palmer, D., Kueker, J., & Stowe, M. (1987). An illustrative application of microcomputer technology to the study of reading. In R. D. Zelner (Ed.), Technology in education: Implications and _applications_. Report No. IR01-3-493. College Station, TX: Texas A and M University, Instructional Research Lab. (ERIC Document Reproduction Service No. ED 301 153)

Powell, B. (1984). Five-year-old authors: Dr. John Henry Martin has kindergartners reading and writing as if they were born knowing how. _Family Computing_, _3_(2), 58-60.

Rhodes, L. (1986). On computers, personal styles, and being human: A conversation with Sherry Turkle. _Educational Leadership_, _43_(6), 12-16.

Rosegrant, T. (1985). Using the microcomputer as a tool for learning to read and write. _Journal of Learning Disabilities_, _18_, 113-115.

Rubin, A., & Bruce, B. (1984). _QUILL reading and writing with a microcomputer. Reading education report no. 48_ Report No. CS00-7-506. Cambridge, MA: Bolt, Beranek, and Newman, & Urbana, IL: Illinois University Center for the Study of Reading. (ERIC Document Reproduction Service No. ED 240 516)

Sankar, Y. (1986). Evaluation of computer-assisted instruction. _Programmed Learning Education Technology_, _25_, 314-321.

Saracho, O. N. (1985). The roots of reading and writing. In L. B. Gambrell & E. M. McLaughlin (Eds.), New directions in reading: Research and practice. 1985 yearbook of the State of Maryland International Reading Association (pp.81-86). Maryland: International Reading Association, Maryland Council.

Schaudt, B. (1987). The use of computers in a direct instruction reading lesson. Reading Psychology, 8, 169-178.

Scott, D., & Barker, J. (1987). Guidelines for selecting and evaluating reading software: Improving the decision making process. The Reading Teacher, 40, 884-887.

Shuman, R. B. (1987). The first R: Fundamentals of initial reading instruction. Developments in classroom instruction. Washington, D.C.: National Education Association.

Slavin, R. E., & Madden, N. A. (1989). What works for students at risk: A research synthesis. Educational Leadership, 46(5), 4-13.

Smith, N. (1985). The word processing approach to language experience. The Reading Teacher, 38, 556-559.

Smith, N. J. (1984). The word processing approach to language experience. Report No. CS00-7-784. Kansas. (ERIC Document Reproduction Service No. ED 249 465)

Squire, J. R. (1985). Discussions at the mid-decade seminar on the teaching of reading and English. Chicago: National Conference on Research in English. (ERIC Document Reproduction Service No. ED 274 967)

Staff. (1988). Whither Dick and Jane? Instructor, 97(10), 132.

Sturdivant, P. (1986). Planning and training for a new educational delivery system. Educational Leadership, 43(6), 38-40.

Swinton, S. S. (1978). The PLATO elementary demonstration educational outcome evaluation. Final report: Summary and conclusions. Report No. IR00-8-386. Urbana, IL: Illinois University Computer-Based Education Lab. (ERIC Document Reproduction Service No. ED 186 020).

Teague, M., Teague, G., & Marchionini, G. (1987). Exploring the use of electronic information services with elementary students. Education and Computing, 3, 179-184.

Thompson, R. A. (1984). Computer assisted reading instruction research. Paper presented at the annual meeting of the International Reading Association, Atlanta, GA. (ERIC Document Reproduction Service No. ED 243 091)

Tomlinson, L. M. (1980). Overview of computer applications in readings. Report No. CS00-8-618. Wisconsin. (ERIC Document Reproduction Service No. ED 276 978)

Trumbull, D. J. (1986). Games children play: A cautionary tale. Educational Leadership, 43(6), 18-21.

Tucker, M. S. (1985). Computers in the school: What revolution? Journal of Communication, 35, 12-23.

Valdez, G. (1986). Realizing the potential of educational technology. Educational Leadership, 43(6), 4-6.

Vinsonhaler, J. F., & Bass, R. K. (1972). A summary of ten major studies on CAI drill and practice. Educational Technology, 12(7), 29-32.

Wagner, B. J. (1985). ERIC/RCS report: Integrating the language arts. Language Arts, 62, 17-18.

Walker, R. J. (1980). An update on computers in the classroom. Arlington, VA: John Wiley & Sons.

Wallace, J. M. (1985). Write first, then read. In J. M. Ewing (Ed.), Reading and the new technologies, Proceedings of the annual conference of the United Kingdom Reading Association (pp. 128-133). Dundee, Scotland: Heineman Educational Books. (ERIC Reproduction Service No. ED 278 944)

Wepner, S. B. (1988). Recap--reading/computers assessment plan. The Reading Teacher, 41, 452-453.